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ZINC OXIDE NANOPARTICLES AS SKIN PERMEATION ENHANCER FOR SOLVENTS AND SURFACTANTS

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ABSTRACT

Objective: Transdermal route of drug administration has absorbed largeinterests for its many advantages. Several materials, mainly different solvents and surfactants, have been used as excipients to enhance the skin permeation of drugs.Nanoparticles (NPs) also have been proved to affect the permeations of substances.ZnO-NPs, widely used in topical products, have been investigated in this study in terms of their effects on permeations of different substances (excipients) and therefore permeations of active ingredients.

Method: To determine the skin permeation of everysubstance, diffusion cell method and a cut of chicken skin were employed following by quantification of the substance concentration in the receiver medium after 1.5 hours.

Results: The substances showed different permeations. The ZnO-NPs increased the permeation of each substance. In the absence and also in the presence of the ZnO-NPs, the mean amounts permeated were respectively belonged to hydrophobic solvents, hydrophilic solvents, oily solvents and surfactants. The ZnO-NPs increased the permeation ofhydrophobic solvents, oily solvents, hydrophilic solvents and surfactants, with 31.33, 24, 20.33 and 5.34%, respectively. Such increases, were not dependent on the molecular weight (MW) of the oily and hydrophobic solvents but were dependent on the MW of the hydrophilic solvents and the surfactants.

Conclusion: The ZnO-NPs are suggested to be used for enhancing the skin permeations ofsolvents or surfactantsin topical productswhich potentially can improve absorption of active ingredients. Besides, such enhancing effect of the ZnO-NPs should be noticed in topical products where they may increase drug delivery dose and alsoincrease drug or excipient systemic toxicity.

Keywords: *ZnO nanoparticles; Skin permeation; solvent; surfactant.*

INTRODUCTION

Transdermal drug route of administration has lots of advantages including easy, safe, non-invasive, painless, decreased or loss of first-pass drug metabolism, no gastro-intestinal degradation, long time delivery (>24 hours) (Especially transdermal patches), controlled delivery, controlled termination, bypassing GI absorption steps, dramatic pH changes, enzyme effects and transit times,and ultimately easier preparation of the dosage forms than the parenterals[1]. The most important barrier for transdermal drug delivery is the skin's horny layer or stratum corneum (SC). This layer must be altered for penetration of drugs through the skin. This has been the subject of research for pharmaceutical scientists during the two latest decades[2]. Extensive research on chemical penetration enhancers (CPEs) has been performed during the latest 20 years which form the main strategy of formulation-design approaches for transdermal drug delivery[3]. It is now well known that formulation components can improve the quantity and rate of transdermal absorption of drugs[4]. Permeation of a drug through the skin in the presence of an enhancer is related to physico-chemical characteristics of the enhancer and the drug[5-7]. More than 200 chemicals have been shown to enhance skin permeation of drugs. Chemical penetration enhancers should construct a situation to make new skin microstructures[3].

Several enhancers have been used to enhance skin permeation of different drugs mainly including aliphatic acids, fatty acids, esters, alcohols, oils and terpens[1,8,9].

One group of penetration enhancers are hydrophobic nanoparticles (NPs) made from lipids, hydrophobic polymers, etc. Such polymers should be evaluated in terms of safety, biocompatibility and especially degradation kinetics. Therefore, they should be accurately designed to become suitable for use in medications[10-12].

Zinc is a relatively inexpensive, biocompatible and non-toxic essential element for human health[11]. Parat et al. proved that Zinc is safe and has antioxidant and cytoprotective effects on skin keratinocytes in cell (HaCaT) culture[13]. Zinc oxide (ZnO) (molecular weight (MW): 81.408 g/mol) has been applied topically to heal wounds and treat other skin disorders[14]. The zinc distribution peaked in the epidermal layer and decreased toward the SC, with the exception positioned in the SC[15-17].

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